NASA TECH BRIEF
NASA Pasadena Office

Precision Voltage Regulator

The problem:

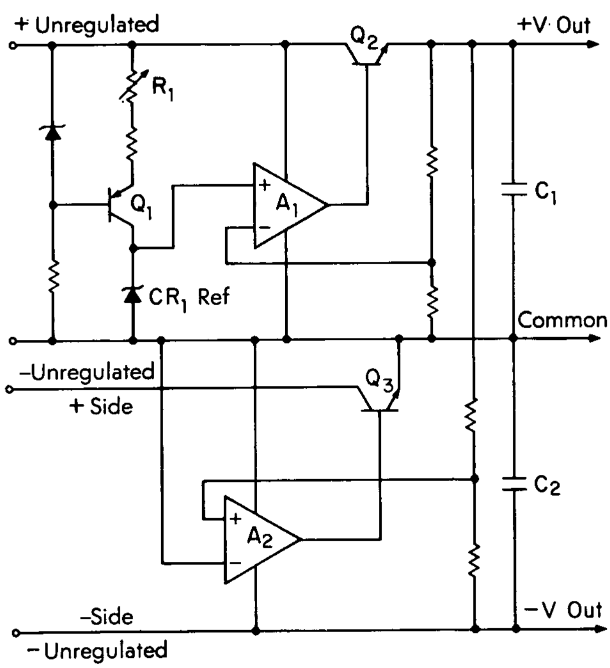
To design an efficient voltage regulator for use with an inertial reference unit; the voltage supplied to the integrator in the inertial unit must remain constant in spite of ambient temperature changes, input supply variations, and load changes resulting from demands by other circuits on the voltage regulator.

The solution:

A balanced positive and negative voltage output circuit in which the error voltage for control is developed from the difference in absolute value of the positive and negative voltages referenced to a common point. Fast-acting temperature-compensated, high-gain operational amplifier circuits maintain the common point at an equipotential value between the two.

How it's done:

The circuit is indicated schematically in the diagram. A constant current is supplied to the precision, aged, temperature-compensated Zener diode CR1 by means of transistor Q1 and associated components; variations of the Zener current due to the effect of temperature fluctuations on the V_{be} of Q1 are automatically compensated by changes in the value of the silicon resistor R1 (sensistor). The voltage drop across CR1 is compared by means of the high-gain monolithic operational amplifier A1 with a similar voltage obtained by means of a voltage divider across the +V output and the common terminal. The extremely high gain of the amplifier (typically in excess of 150,000) causes the difference between these voltages to be very small, however, any variation between the compared voltages is supplied as an error signal by A1 to the series transistor Q2. The sense of the error signal is such as to cause the voltage drop across Q2 to decrease if the output voltage becomes lower, or to increase if the output voltage rises.



Operational amplifier A2 is identical with A1 and operates analogously; it compares the difference between the negative and positive output voltages with the output common point, thus causing the negative output voltage to track the positive output voltage. Error signals from A2 control the series transistor Q3 in the same manner as those from A1 control Q2.

(continued overleaf)

Notes:

1. Output impedance at higher frequencies is reduced by C1 and C2.
2. For maximum performance, all comparison and division resistors must be precision wire-wound types with low temperature coefficients, and the location of voltage-sensing points must be carefully controlled.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: TSP72-10092

Patent status:

No patent action is contemplated by NASA.

Source: Patrick J. Hand and
Richard A. Crawford of
Caltech/JPL
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